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THE EFFECTS OF PRESSURE UPON LINES IN THE SPECTRUM OF IRON.

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Humphreys and Mohler[1], in 1896-7, made an extended study of the effect of pressure upon the wave frequencies of the lines of the emission spectra of a larger number of the metalic elements. The source used was an enclosed electric arc about which the air pressure could be varied, the pressure being carried up to fourteen atmospheres. The results of their experiments indicate that all isolated lines shift toward the red end of the spectrum with increased pressure, the shift being proportioned to the wave length for lines of a given series, but the factor of proportionality being different for lines of different series.

In the winter of 1901-2 at the suggestion of Professor Michelson, I undertook the measurement of the pressure shift of some of the lines of the spectrum of iron by a method quite similar to that employed by Humphreys and Mohler, but with essential differences. The source of light employed was a self induction spark produced by rotating a sprocket-wheel by a steel spring. The spark gap was contained within a cast brass vessel with properly packed shaft for driving the sprocket wheel and insulated leads, and a plate glass window. An image of the spark was formed upon the slit of a grating spectrometer. The spectrum was formed by a 5-inch Rowland concave grating of 21 feet radius ruled 20,000 lines to the inch. My study was confined to the second order spectrum in which the dispersion was such that 1 Angstrom unit was approximately 1 mm. in the spectrum; and to that part of the spectrum of iron lying between wave lengths 4014 and 4528. The photographs were made by the ordinary method of three exposures to check any accidental displacement of the plate.

The pressure shifts found for the lines in this region conformed very closely to those published by Humphreys. Of the iron lines in this region certain of the broader, denser lines are reversed at their centers in the spectra under pressure. This is particularly evident in the lines 4045, 4063, 4071, 4271, 4308, 4325, 4383 and 4404. It may be noted that these reversals agree with those noted by Professor Hale[2] when the spark gap was under pressure in a liquid, and later observed by Hale and Kent[3].

After a somewhat extended study of this region of the spectrum of iron by means of the grating spectrometer, I attempted to apply the echelon spectrometer to the problem of pressure shift.

The same source was employed as before, the light first passing through a prism spectrometer using two 60° carbon bisulphide prisms in succession, which gave sufficient dispersion so that lines separated by 1

Angstrom unit could be placed separately upon the slit of the echelon spectrometer. To facilitate the arrangement and manipulation of the apparatus a plane mirror was introduced between the colimator and the prisms, which permitted of rotation so that any line of the prism spectrum could be placed upon the slit of the echelon spectrometer. The echelon consisted of 30 plates, 5 mm. thick and 1 mm. width of step. This would make the order of spectrum employed of the order of 5000, which would make the dispersion several times that of the grating spectrometer previously employed. The eye piece of the echelon spectrometer was fitted with a plate holder, for photographic work.

Considerable work has been done by eye observation and some 200 negatives were taken of the most interesting lines of the iron spectrum but as bearing upon the pressure shift they only contribute evidence confirming the unsymmetrical broadening toward the red.

1 Ap. Jour. 6; 169; 1897.
2 Ap. Jour. 15; 132; 1902.
3 Ap. Jour. 17; 154; 1903.